Armored Reconnaissance Vehicle (ARV) Advanced Technology Development

Future Naval Capability (FNC) Program

BAA Overview and Science and Technology Opportunities

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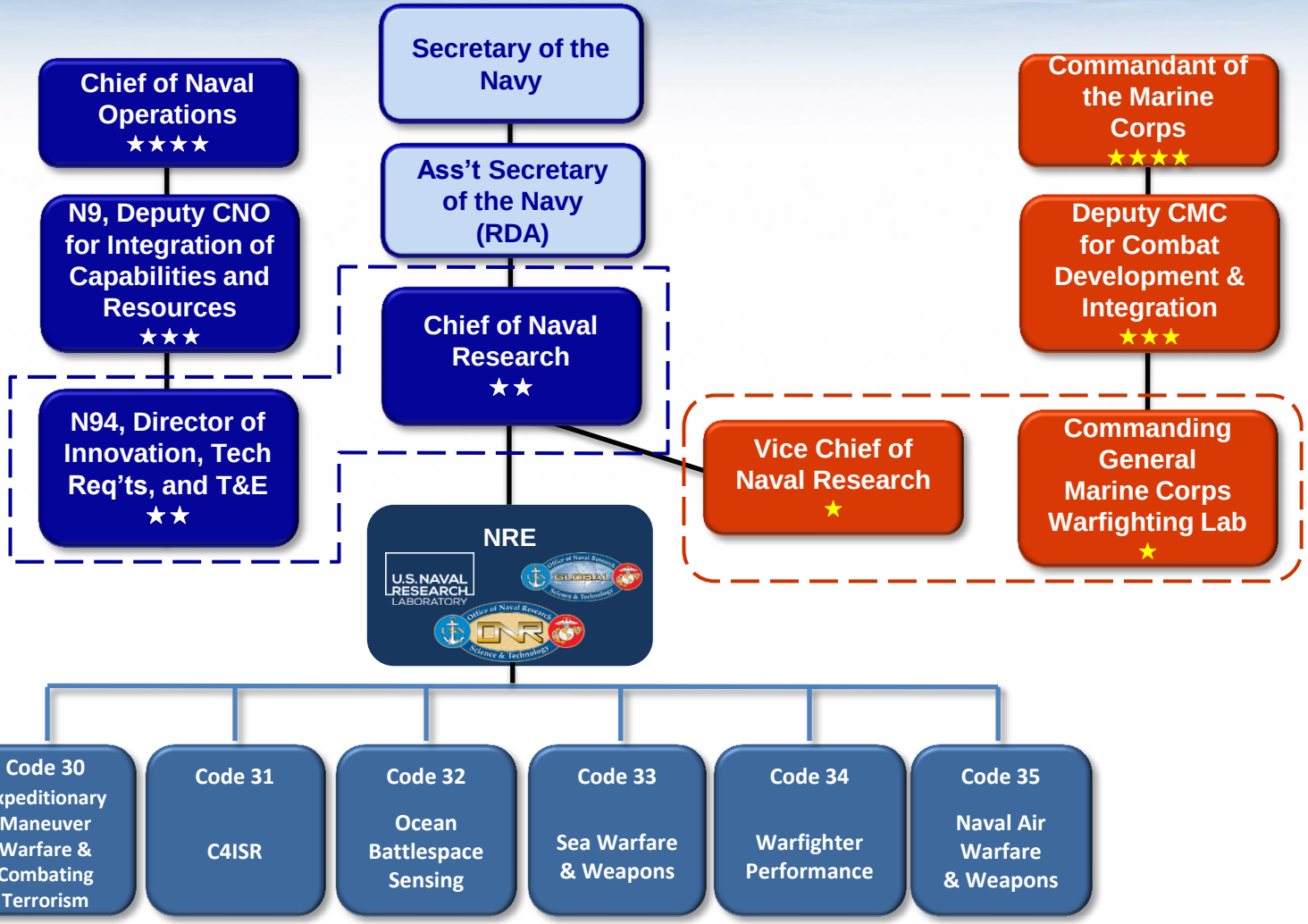
Agenda

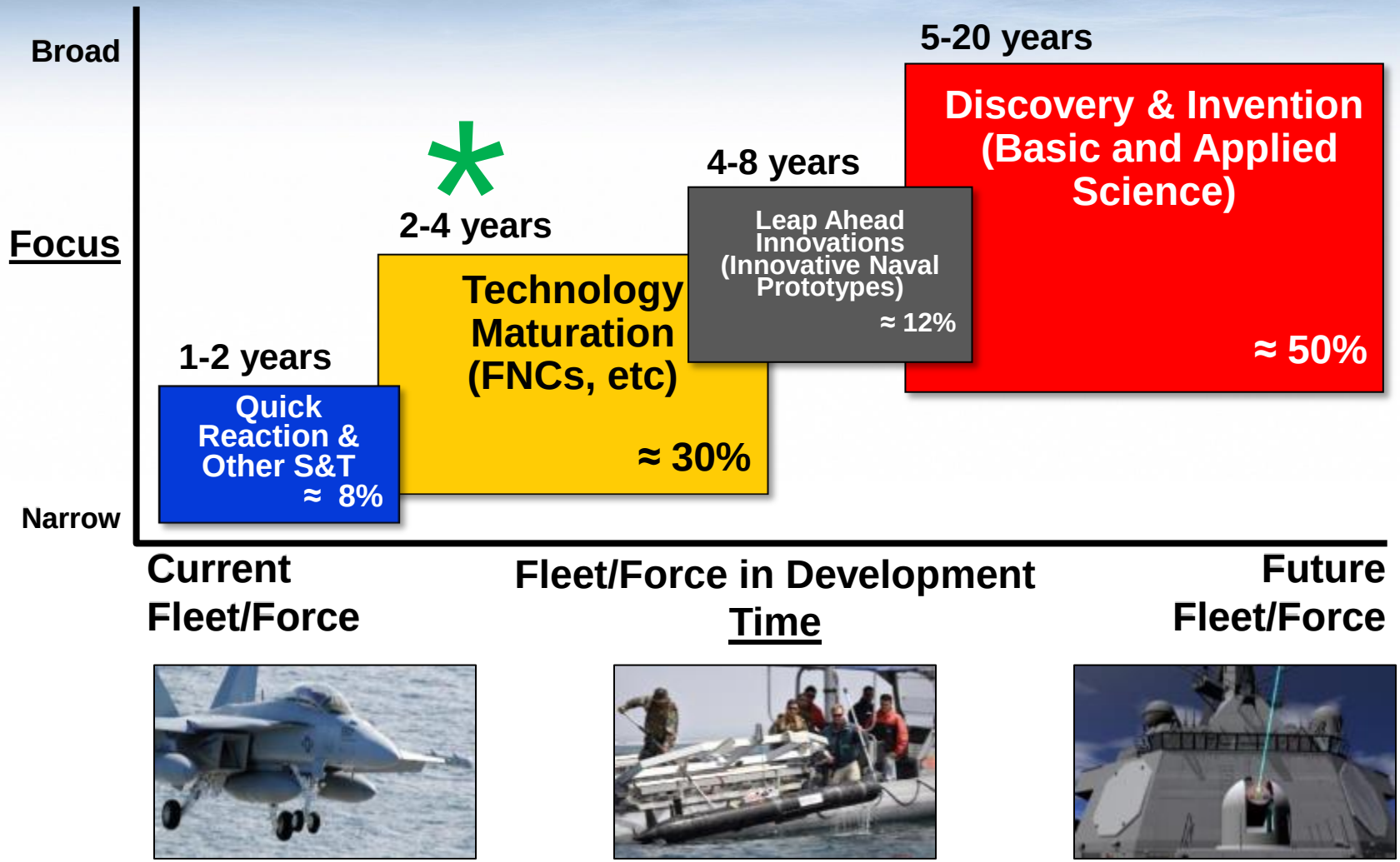
- Office of Naval Research (ONR) Overview
- ARV S&T Program Objectives
- Schedule/Timelines
- Research Areas
  - Research Area 1 (RA1): Advanced Component and Subsystem Technology Research and Development
  - Research Area 2 (RA2): Full System Concept Studies, Mockup Fabrication, and Full System Technology Demonstrator Prototype Development
- Conclusions/Final Thoughts

Office of Naval Research (ONR) and Naval Research Enterprise Organization

ONR is the lead agency for Navy and Marine Corps Science and Technology



Warfighting Capabilities Enabled by S&T Investments

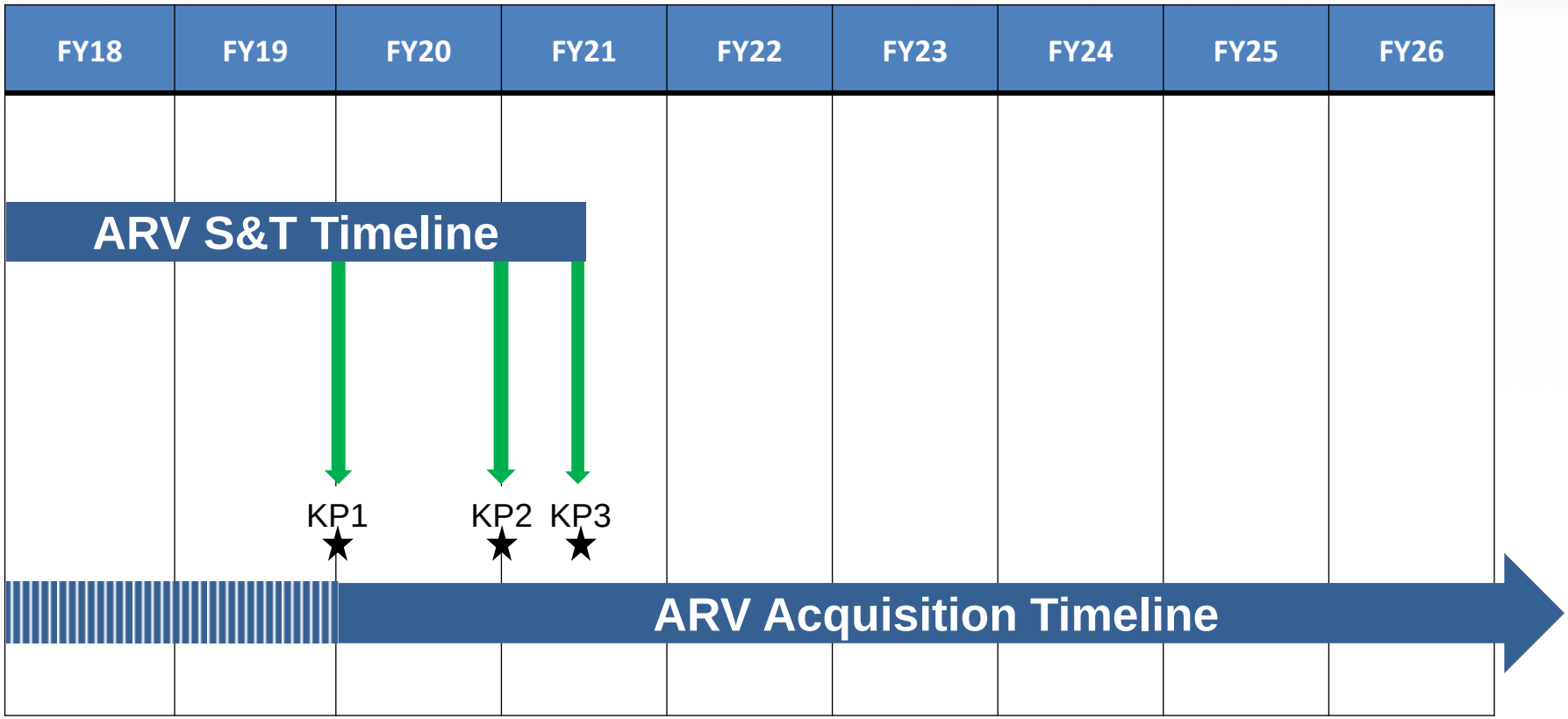


ARV S&T Program Objectives

- Research and develop advanced/revolutionary technologies for consideration during the acquisition phase
  - Research Area 1 (Component & Subsystem Level Research)
- Research, demonstrate, and evaluate the state of the art at the system level
  - Research Area 2 (Concept studies, M&S, Mock ups, Base Variant and At the Edge Demonstrators, Government Testing)
- Inform the art of the possible and assist the Marine Corps as they refine their ARV Requirements and Acquisition documentation
- Jump start and engage Industry, Academia, and Gov't Labs as early as possible

Schedule/Timelines

ARV S&T FNC program is a 3 1/2 year effort ending in mid-FY21



** KP = Knowledge Point*

BAA Schedule

Near-term Key Dates

Event	Date
White Papers Due	January 19, 2018 – 3:00 PM EST
Request for Proposals*	February 2, 2018
Full Proposals Due	March 16, 2018 – 3:00 PM EST
Awardees Selected*	March 30, 2018
Contracts Awarded*	July 30, 2018

* Estimated dates

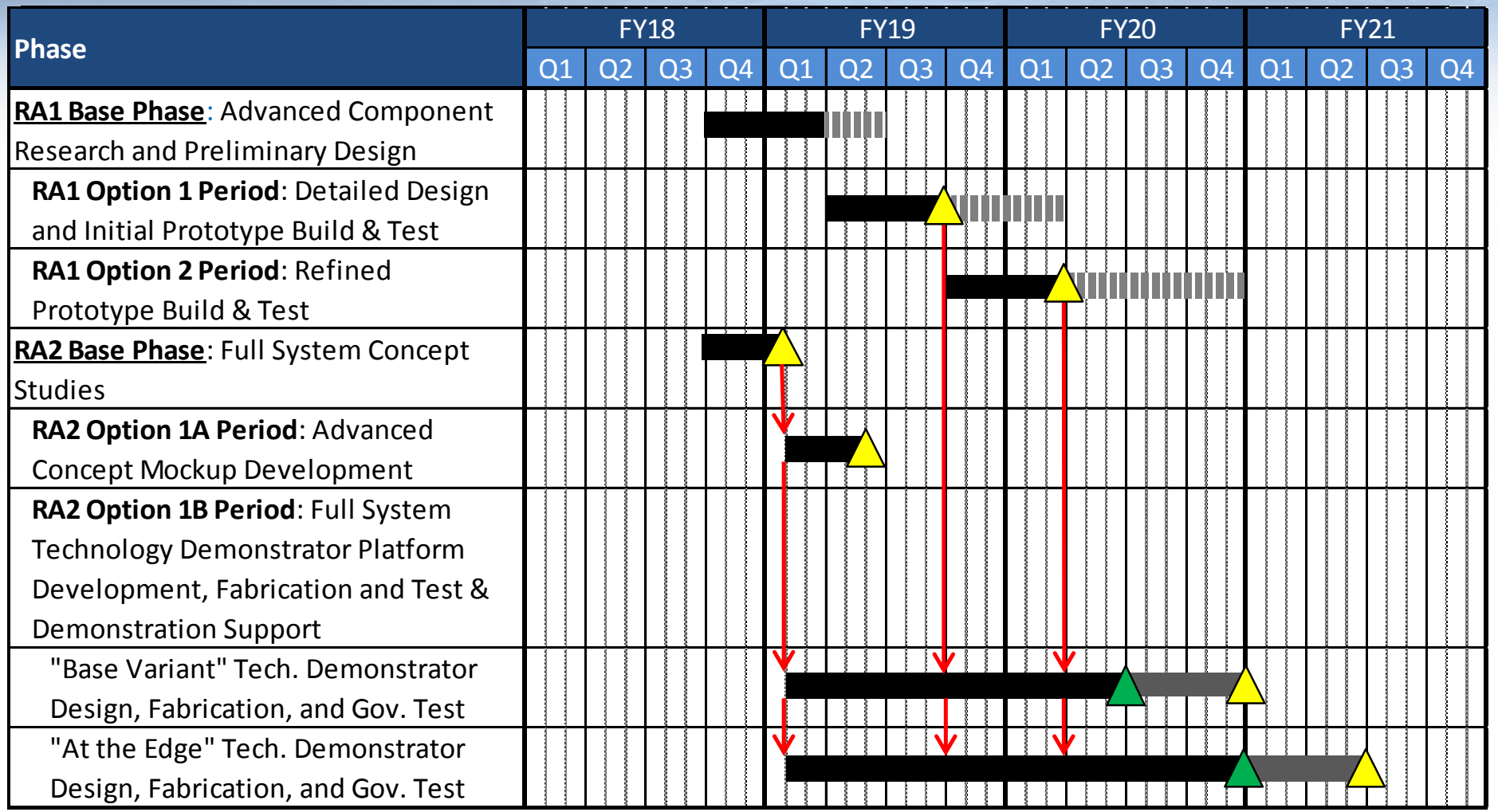
BAA Contracting Instruments

- Both Procurement Contracts and Other Transactions for Prototypes (OTA) were mentioned in the BAA
  - These contract instruments are offered to provide flexibility
  - Not recommending or advocating one over the other
  - Up to you to select and propose to the desired mechanism
  - Required proposal documentation is similar for both instruments
- Procurement Contracts
  - Can be used for all research areas
- OTAs
  - May provide greater flexibility for non-traditional and small businesses
    - No cost share or partnering required
  - Traditional defense contractors can propose an OTA but will require 1/3 cost share and/or significant partnering with non-traditional contractors

Research Area Overview

- S&T program is separated into two (2) Research Areas (RA):
  - **Research Area 1 (RA1):** Advanced Component and/or Subsystem Technology Research and Development
  - **Research Area 2 (RA2):** Full System Concept Studies, Mockup Fabrication, and Full System Technology Demonstrator Prototype Development
- Each Research Area consists of a base period and option periods
  - Options under RA1 are sequential
  - Proposer must select which option to propose under RA2. Options are not sequential.

BAA S&T Program Schedule



Transition: △ **Linkages:** → **Schedule:** ▬ **Additional Time If Needed:** ▬ **Government Testing:** △▬

Research Area 1
Overview

- **Research Area 1 (RA1):** Advanced Component and/or Subsystem Technology Research and Development
  - Research and develop new and revolutionary technologies at the component level
    - Interested in technologies starting from TRL 2 – 5
      - Goal is to mature technologies to TRL 6, if possible
    - Technology efforts will inform the realm of the possible and have future ARV application beyond the S&T program
    - Some technologies may be considered for integration into the Technology Demonstrators being developed under RA2

Research Area 1
Overview

- Base Period: Research and Preliminary Design
  - 6 months, up to $250K each
- Option 1: Detailed Design and Initial Prototype Build & Test
  - 6 months, up to $500K each
- Option 2: Refined Prototype Build & Test
  - 6 months, up to $500K each

Research Area 1
Technology Focus Areas (TFA)

TFA 1:	Propulsion
TFA 2:	Mobility
TFA 3:	Autonomy/Manned-Unmanned Teaming
TFA 4:	Weapons
TFA 5:	Force Protection/Survivability
TFA 6:	Vehicle Architectures
TFA 7:	Logistics
TFA 8:	Sensors
TFA 9:	Communication
TFA 10:	Battle Management System

Research Area 1
TFA 1 and TFA 2

- **TFA 1: Propulsion**
  - Consider novel propulsion technologies to increase power density and reduce platform size/space claim
  - Electric power generation systems that can accommodate electric drive and high-power weapon systems and payloads
  - **Potential Research Ideas:**
    - Electric/hybrid drive, increased power dense engines/transmissions, on-board vehicle power generation, fuel consumption reduction, etc.
- **TFA 2: Mobility**
  - Increase ability to traverse complex terrain while achieving a greater operational tempo
  - On-board and remote sensors and advanced chassis components / subsystems / controls
  - **Potential Research Ideas:**
    - Smart tire and track concepts, advanced suspensions, predictive and adaptive off-road mobility sensors/systems, chassis control algorithms, etc.

Research Area 1
TFA 3

- **TFA 3: Autonomy/Manned-Unmanned Teaming**
  - Provide a vehicle organic capability to perform mission specific behaviors utilizing input from various advanced sensors
  - Provide an ARV vehicle capable of transitioning from manned operation by a crew of marines to an un-manned operation as a semi-autonomous wingman
  - Ability to coordinate autonomous behaviors across a team of heterogeneous unmanned and manned systems
  - Extend reconnaissance reach and surveillance persistence with organic platform-launched UAS capable of long-range/long-duration flight
  - Unmanned systems capable of secure RSTA information transmission from beyond line of sight
  - Ability to remotely control fires and autonomously maneuver individual ARV platforms to provide broader coverage within an area of operations, increase unit lethality, enable more rapid and accurate engagements, feign friendly intentions as decoys, and offset the signature risk to ARV crews
  - **Potential Research Ideas:**
    - Advanced autonomous sensors, perception, and collaborative behavior technologies; unmanned wingman; unmanned lead vehicle concepts; etc.

Research Area 1
TFA 4

- **TFA 4: Weapons**
  - Provide mission reconfigurable weapons packages, including kinetic and non-kinetic systems to address a multitude of threats to be engaged from a single or multiple heterogeneous vehicles
  - Improved lethal and non-lethal fires capable of delivering effects at extended ranges
  - Anti-armor capability with increased accuracy and lethality
  - Advanced, networked, and multi-function electronic warfare capability
  - **Potential Research Ideas:**
    - Directed energy weapons, anti-armor weapons, electronic warfare systems, modular/reconfigurable weapon systems, counter-UAS weapons, etc.

Research Area 1
TFA 5

- **TFA 5: Force Protection/Survivability**
  - Integrated active and passive protective systems capable of detecting and neutralizing a variety of threats at sufficient distances to enable the survivability of the crew
  - Minimize armor weight to protect occupants against armor-piercing direct fire medium and large caliber threats up to heavy machine gun, indirect high explosive fragmentation, landmines, and IEDs, to maximize transportability, off-road mobility, and buoyancy in the water
  - Be survivable against the broad range of threat effects of kinetic energy and directed energy weapon attacks without a total loss of mobility or system functionality
  - **Potential Research Ideas:**
    - Active protection systems, counter tactical surveillance and targeting systems, slew-to-cue, lightweight armor materials, improved signature management across the EM spectrum, overmatch mitigation, fire suppression systems, damage resistant tires, blast protective seats, resilient fuel systems, CBR protection, DEW/laser protection, EMP protection, low-observable technologies to reduce the vehicle passive and emitted signatures, etc.

Research Area 1
TFA 6 & TFA 7

- **TFA 6: Vehicle Architectures**
  - Cyber-secure and electronic-warfare protected advanced vehicle architectures that inherently enable advanced communication protocols and power distribution & management to accommodate modularity for future advanced payloads (weapons, APS, EW packages, etc.)
  - **Potential Research Ideas:**
    - Concepts allowing maximum mission re-configurability, cyber-secure control systems, etc.
- **TFA 7: Logistics**
  - Substantially reduce the logistics footprint of platforms through incorporation of fuel efficient propulsion systems and increase operational availability through the utilization of condition based maintenance systems and resilient systems allowing degradation in performance rather than a loss in capability
  - **Potential Research Ideas:**
    - CBM+, resilient systems, platform health self-diagnosis, etc.

Research Area 1
TFA 8

- **TFA 8: Sensors**
  - Sense and identify weapons and targets through obscurants, beyond threat range, and beyond line of sight with a vehicle-mounted system and organic small-unmanned air and ground systems capability
  - Transmit sensing and targeting information between the crew, the dismounted scout team, other ARV crews, and other MAGTF and joint sensing assets
  - Sensing in the deep area that will enable rapidly coordinated and executed fire missions against adversary personnel, armor, equipment, and facilities
  - **Potential Research Ideas:**
    - Sensors capable of operating in degraded vision environments and which expand sensing capacity of LAR unit over a broader operating area, sensors to increase local area SA such as see through armor technology and target motion indicator/sensing capability, etc.

Research Area 1
TFA 9

- **TFA 9: Communication**
  - Redundant, resilient, and rapidly upgradeable joint-interoperable communications that enable the command and control of LAR elements to support armored reconnaissance and security operations at extended ranges and beyond line of sight
  - Communications capabilities able to operate in jammed/denied EM environments
  - Protected, high-bandwidth information exchanges, ingest and disseminate information such as target quality data, high-resolution imagery, and video at near real-time speeds utilizing multiple waveforms
  - **Potential Research Ideas:**
    - Resilient communication systems, high bandwidth and secure communication, etc.

Research Area 1
TFA 10

- **TFA 10: Battle Management System**
  - A combat vehicle mounted system that fuses sensors, communications, command and control applications, and weapons to form tactical level coordinated battle teams that perform their tasks with greater aggregate effectiveness
  - Supports the requirements of battalion-and-below tactical units, meeting their operational needs, including direct fire engagement & maneuver, indirect fire support, intelligence and logistics.
  - **Potential Research Ideas:**
    - Battle Management System and related subsystems.

Research Area 2
Overview

- **Research Area 2 (RA2):** Full System Concept Studies, Mockup Fabrication, and Full System Technology Demonstrator Prototype Development
  - Research and develop novel concepts for both a “Base Variant” and a revolutionary “At the Edge” design
  - Demonstrate those concepts via mockups or technology demonstrators
  - Demonstrator definitions:
    - “Base Variant”: Advanced technologies and capabilities to push the state of the art given certain constraints (size, weight, timeframe, and price point)
    - “At the Edge”: Far-term future generation-after-next-technologies to push the upper limits of capability and performance given few constraints (size and weight only)

Research Area 2
Overview

Base Period: Full System Concept Studies (for both Base Variant and At the Edge designs)		
Option 1A: Advanced Concept/Subsystem Mockup Development	OR	**Option 1B:** Full System Technology Demonstrator Prototype Development, Fabrication and Test & Demonstration Support

– If proposing to an Option, select one or the other, but not both

Research Area 2
Base Period

- Concept Studies:
  - Each offeror is expected to conduct and deliver concept studies for both a “Base Variant” and “At the Edge” ARV platform
  - Concepts should use physics-based analytical and modeling and simulation tools and a systems-based approach
    - Explore various advanced component and sub-system technologies
    - Conduct whole system trade studies and M&S to optimize designs
    - Determine/predict platform performance capabilities
  - 4 months, up to $400K each

Research Area 2
Option 1A

- Advanced Concept/Subsystem Mockup Development
  - Develop low-cost or virtual mockups of a unique design feature or subsystem
    - Not a full platform/system mockup
  - Purpose is to aid in the visualization of an important technology or feature without the need to develop a fully functioning prototype
  - 4 months, up to $250K

Research Area 2
Option 1B

- Full System Technology Demonstrator Prototype Development, Fabrication, and Test & Demonstration Support
  - Offerors can propose to the 'Base Variant", the "At the Edge", or both demonstrators
  - Base Variant demonstrator
    - 17 months design/fabrication/shakeout, 6 months Gov't testing, up to $10M
  - At the Edge demonstrator
    - 23 months design/fabrication/shakeout, 6 months Gov't testing, up to $15M

Research Area 2
Option 1B: "Base" Variant

- Nearer-term design containing state-of-the-art technologies
- Constraints:
  - Notional Average Manufacturing Unit Cost (AMUC) of $6.0M per platform for 500 units
  - Projected Initial Operating Capability (IOC) in 2027
  - Platform weight should not exceed 29,600 lbs (with 25% weight growth margin designed in)
  - Overall size should approximate the current LAV
- Demonstrator platform must be an operational system with sufficient durability to withstand testing in a relevant environment to collect data and assess overall platform capability
- Technology Readiness Level (TRL) of approximately 6 is desired

Research Area 2

Option 1B: "At the Edge" Variant

- Far-term, forward-looking revolutionary concept
- There are not any constraints on unit cost for this platform and there is no defined IOC
- Only constraint is weight and size (should not exceed 29,600 lbs with 25% weight growth margin designed in and overall size should approximate the current LAV)
- Platform is to be operational but is not expected to be designed with the durability necessary to withstand sustained operations in relevant terrain environments
- TRL of approximately 5 is acceptable

Research Area 2

Option 1B: Notional Technology Demonstrator Capabilities

a) A self-healing, cyber-safe electrical and data distribution architecture with the capability for expansion to support future capability insertion and ability to be easily updated as architecture components become obsolete (keeping pace with Moore's law).

b) Power pack (engine/transmission) that yields maximum horsepower per ton capability while yielding significant fuel efficiency. Threshold would support 70% off road and 30% on road mobility even with eventual weight growth.

c) Power generation growth that powers all systems on vehicle with a 25% power buffer and supports an eventual 100% growth within 10 years for power & distribution, data distribution & processing, and memory storage without performance degradation.

Research Area 2

Option 1B: Notional Technology Demonstrator Capabilities

d) Direct fire, underbody, and top attack vehicle protection.

e) Energy attenuation seats that support IED protection for a space constrained lightweight vehicle.

f) Water mobility sufficient to support shore to shore operations.

g) Vehicle volume and weight that enables four ARVs to be transported on current and future versions of LCAC. For the purposes of the S&T effort, all designs should not exceed a GVW of 29,600 lbs. but should accommodate a 25% weight growth margin up to a GVW of 37,000 lbs.

h) Suspension and structural capacity to support 25% weight growth margin over the life of the vehicle while ensuring ride quality (both on road and off road).

Research Area 2

Option 1B: Notional Technology Demonstrator Capabilities

i) Firepower equivalent to minimum of 30mm direct fire primary weapon and support future growth to higher caliber weapons.

j) All-weather, full spectrum operations for both vehicle mobility and individual crew vision to support superior reconnaissance capability over any currently fielded lightly armored vehicle.

k) A C4I architecture that aligns with MAGTF communication requirements that supports four-year technology refresh updates. This architecture will support secure voice, video, and data exchanges in GPS denied environments.

Research Area 2

Option 1B: Notional Technology Demonstrator Capabilities

l) Interfaces to support the transportation, deployment, retrieval, data transmission, recharging, and control of Unmanned Aerial Systems (UASs) and Unmanned Ground Vehicles (UGVs).

m) Modularity to allow flexibility for the insertion of emerging technologies and also current and future multi-mission payloads.

n) Manned/Unmanned teaming operations through the incorporation of robotics and autonomy.

Conclusions

- White papers due 19 January 2018 for RA 1 and RA 2
- Proposals due 16 March 2018
- All contract awards expected by late July 2018

- Today's briefings and Questions/Answers can be found at this site.
  - https://www.onr.navy.mil/ARV-industry-day

Final Thoughts

- Have we lost our technological advantage?
- "I never, ever want my Sailors and Marines to be in a fair fight."
  - ADM Roughead, former CNO
- We have a rare opportunity to influence the design of a next generation combat system from the ground up
- Collectively, we must pursue unmatched ARV technologies / capabilities for the future battlefield and we ask for your A-team and full Corporate support

Thank you! We look forward to your white papers and proposals